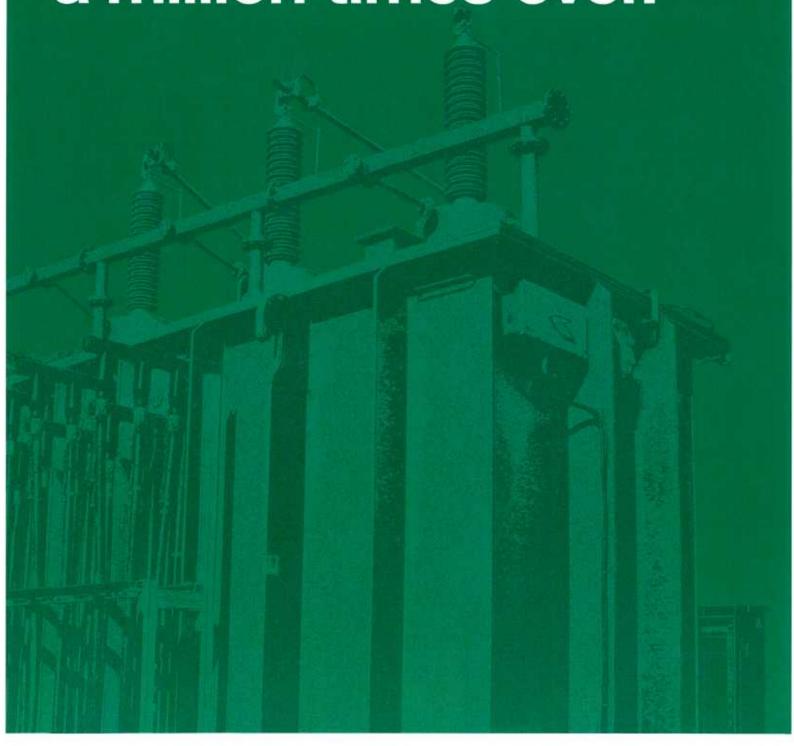


Envirotemp FR3 fluid. Trusted worldwide a million times over.



With over one million installations across six continents and validated in over 250 tests, Cargill's Envirotemp™ FR3™ natural ester fluid is trusted by our customers to deliver cost-effective solutions that help improve transformer performance reliably and safely.

Our team of dielectric experts is active in the standards community globally and has extensive knowledge of not only dielectric fluid properties but also fluid performance in application. And they have transformer design experience, too. This means our customers adopting FR3 natural ester technology have comprehensive dielectric fluids support from initial planning stages through best practices implementation and beyond.

Backed by Cargill's global supply chain network, our customers can rely on us to deliver the best solution for their application when they need it, anywhere in the world.

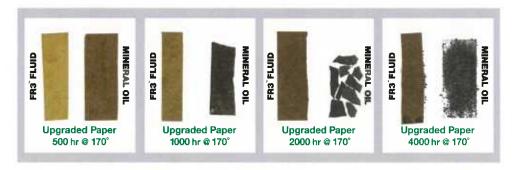
With FR3 fluid, our customers can:

- Gain cost efficiencies either on initial cost or total cost of ownership without sacrificing reliability.
- Extend transformer insulation and asset life.
- Optimize load capacity.
- Significantly improve fire safety.
- Enhance their environmental footprint and sustainable supply chain initiatives.

Improve performance with life extension and loading flexibility.

Protect insulation life to extend asset life.

Insulation paper is one of the primary factors that determines the life of a transformer. FR3[™] fluid's unique chemistry absorbs free water and essentially wicks it away from the insulation paper. FR3 fluid has 10 times the water saturation level of mineral oil. This results in extending the insulation life 5-8 times longer than mineral oil.



Insulation aging study comparing thermally upgraded paper using FR3 fluid vs. mineral oil.

- Save significantly on replacement costs by extending the asset life with FR3 fluid.
- Reduce the risk of failure to improve reliability of the transformer.
- Reduce processing maintenance costs, since FR3 fluid does not sludge like mineral oil.

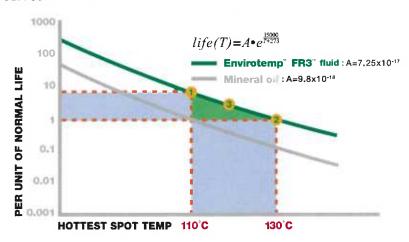
With FR3 fluid's unique capabilities to extend insulation life and increase load capacity, organizations now have the flexibility to optimize their transformer fleet loading profiles in order to gain cost savings without sacrificing reliability.

Leverage higher thermal capability with FR3 fluid.

Historically, standards were written to accommodate a 95°C or 110°C hot spot for cellulose and Thermally Upgraded Kraft (TUK), respectively. However, published high temperature insulation system standards – IEC (60076-14) and IEEE (C157.154) – accommodate a 15°C or 20°C increase in hot spot without sacrificing the life or reliability of the transformer, when immersed in natural ester fluid.

Paper	Dielectric Fluid	Thermal Class	Hot spot	IEEE AWR	IEC AWR
TUK	Mineral Oil	120	110°C	65°C	75K
TUK	Natural Ester	140	130°C	85°C	95K

TUK life curves



OPTION 1: Extend asset life at current 110° hotspot.

OPTION 2: Increase load capability up to 20% with 130°C hotspot.

OPTION 3: Incrementally extend asset life and increase load capability with 120°C hotspot.

IEC 60076-14 Part 14: Liquid immersed power transformers using high-temperature insulation materials. Edition 1.0 September 2013.
IEEE C57.154 Standard for the Design, Testing, and Application of Liquid-Immersed Distribution, Power, and Regulating Transformers Using High-Temperature Insulation Systems and Operating at Elevated Temperature. Published October 30, 2012.

Improve fire safety. Add more sustainability to your sustainable supply chain.

Reduce costs while increasing fire safety.

FR3[™] fluid has the highest fire point of any dielectric fluid (360°C compared to 160°C for mineral oil) making it the ideal choice for densely populated areas where transformers are positioned indoors, underground or in close proximity to buildings and other equipment. FR3 fluid is a K-class, less flammable fluid as certified by Underwriters Laboratory and approved by FM Global.

- Reduce clearance to buildings which saves precious real estate, particularly in space-constrained areas.
- Retrofill older transformers with FR3 fluid instead of replacing or moving them to help comply with current fire code regulations.
- For power transformers, potentially eliminate the need for expensive fire walls and deluge systems (and their ongoing maintenance costs).

"Being green" also benefits your bottom line.

FR3 fluid not only has best-in-class environmental properties, but with its enhanced thermal capabilities enabling smaller transformer designs, your supply chain just got a whole lot more sustainable.

- Smaller, more efficient transformer designs:
 - 1. Use less fluid and construction materials.
 - 2. Are typically lighter which could make installations easier for work crews and could reduce transportation costs.

Envirotemp FR3 fluid properties: standard acceptance values and typical values

	Standard test methods		ASTM D6871/IEEE C57.147	IEC 62770	Envirotemp FR3 fluid
PROPERTY	ASTM	ISO/IEC	As-received new fluid property requirements	Unused new fluid property requirements	TYPICAL
Physical					
Color	D1500	ISO 2211	≤1 0		0.5
Flash Point PMCC (°C)	D93	ISO 2719		≥250	255
Flash Point COC (C)	D92	ISO 2592	≥275		320-330
Fire Point (C)	D92	ISO 2592	≥300	>300	350-360
Pour Point (°C)	D97	ISO 3016	<-10	≤-10	-1823
Density at 20°C (g/cm³)	_	ISO 3675	-	≤10	0.92
Relative Density (Specific Gravity) 15°C	D1298		≤0.96		0.92
Viscosity (mm²/sec)					410000
100°C	D445	100 0101	≤15	≤15	7.7 - 8.3
40°C	D445	ISO 3104	≤50	≤50	32 - 34
0°C			≤500		190
Visual Examinati on	D1524	IEC 62770 4.2.1	bright and clear	clear, free from sediment and suspended matter	clear, light green
Biodegradation	OEC	D 301	readily biodegradable	readily biodegradable	readily biodegradabl
Electrical				Contract of the Contract of th	
Dielectric Breakdown (kV)	D877		≥30		47
Dielectric Breakdown (kV)					
1mm gap	D1816	2.	≥20	-	28
2mm gap	D1816		≥35	-	48-75
2.5mm gap		IEC 60156	-	≥35	73
Gassing Tendency (mm/min)	D2300		≤0	-	-79
Dissipation Factor					
25°C (%)	D924		≤0.20	_	0.010 - 0.15
90°C (tanδ)	_	IEC 60247	-	≤0.05	0.02
100°C (%)	D924		≤4.0	out the company	0.41 - 3.85
Chemical					
Corrosive Sulfur	D1275	IEC 62697	non-corrosive	non-corrosive	non-corrosive
Water Content (mg/kg)	D1533	IEC 60814	≤200	≤200	4 - 50
Acid Number (mg KOH/g)	D974	IEC 62021.3	≤0.06	≤0.06	0.013 - 0.042
PCB Content (mg/kg)	D4059	IEC 61619	not detectable	free from PCBs	not detectable
Total Additives	-	IEC 60666	-	Max weight fraction 5%	<2%
Oxidation Stability (48 hrs. 120°C)	-	IEC 61125C			
Total Acidity (mg KOH/g)		IEC 62621.3		<0.6	0.1
Viscosity at 40°C (mm²/sec)		ISO 3104	-	≤ 30% increase over initial	17.1% increase
Dissipation Factor at 90°C (tanδ)		IEC 60247		≤ 0.5	0.1

NOTE: Specifications should be written referencing only the defined ASTM or IEC industry standard acceptance values and test methods. The listed 'typical' values are average values summarized from a significant number of data points over many years; they are not to be identified as acceptance values.

ASTM D6871 Standard Specification for Natural (Vegetable Oil) Ester Fluids Used in Electrical Apparatus.

IEC 62770: Fluids for electrotechnical applications – Unused natural esters liquids for transformers and similar electrical equipment.

A transformer filled with FR3" fluid complies with the transformer temperature operating range requirements defined in IEEE C57.12.00 and IEC 60076-1.

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- Made from a renewable source with global, reliable supply.
- Carbon neutral (according to BEES 4.0 lifecycle analysis).
- Non-toxic and non-hazardous in soil and water.
- Readily Biodegradable per OECD 301.
- Contains no petroleum, halogens, silicones or sulfurs.
- Recyclable.





















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Printing date: 03.04.2014

Reviewed on: 03.04.2014

1 Identification

Product identifier

Trade name: ENVIROTEMP™ FR3™ Fluid

SAP Material Numbers: 100088941; 100089128; 100089127; 100089129

CAS Number: 8001-22-7

Application of the substance / the mixture: Dielectric coolant

Details of the supplier of the Safety Data Sheet

Manufacturer/Supplier:

Cargill, Incorporated Cargill Industrial Specialties

Cargill Industrial Specialties 9320 Excelsior Blvd.

Hopkins, Minnesota 55343

Tel: 1-952-984-9122

E-mail: CIS_CustomerService@Cargill.com

Emergency telephone number: 1-800-255-3924 (ChemTel)



2 Hazard(s) identification

Classification of the substance or mixture:

The product is not classified as hazardous according to the Globally Harmonized System (GHS).

Label elements

GHS label elements: Not Regulated.
Hazard pictograms: Not Regulated.

Signal word: Not Regulated.

Hazard-determining components of labeling: None.

Hazard statements: Not Regulated.

Hazard description

WHMIS-symbols: Not hazardous under WHMIS.

Classification system:

NFPA ratings (scale 0 - 4)



HMIS ratings (scale 0 - 4)



Health = 0 Fire = 1 Reactivity = 0

Other hazards

Results of PBT and vPvB assessment

PBT: Not applicable. vPvB: Not applicable.

3 Composition/information on ingredients

Chemical characterization: Mixture.

CAS No.: 8001-22-7

Description: Soybean Oil with nonhazardous additives.

Hazardous components: None.

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Trade name: ENVIROTEMP™ FR3™ Fluid

4 First-aid measures

Description of first aid measures

General information:

No special measures required.

After inhalation:

Supply fresh air; consult doctor in case of complaints.

After skin contact:

Generally the product does not irritate the skin.

Clean with water and soap.

If skin irritation continues, consult a doctor.

After eye contact:

Remove contact lenses if worn.

Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.

After swallowing:

Rinse out mouth and then drink plenty of water.

Do not induce vomiting; immediately call for medical help.

Most important symptoms and effects, both acute and delayed:

Gastric or intestinal distress when ingested.

Danger: None

Indication of any immediate medical attention and special treatment needed:

No additional information.

5 Fire-fighting measures

Extinguishing media

Suitable extinguishing agents:

Foam.

Fire-extinguishing powder.

Carbon dioxide.

Gaseous extinguishing agents.

For safety reasons unsuitable extinguishing agents: Water

Special hazards arising from the substance or mixture:

In case of fire, the following can be released: Carbon monoxide (CO)

Advice for firefighters

Protective equipment:

Wear self-contained respiratory protective device.

Wear fully protective suit.

Additional information: No additional information.

6 Accidental release measures

Personal precautions, protective equipment and emergency procedures:

Particular danger of slipping on leaked/spilled product.

Wear protective equipment.

Environmental precautions: Do not allow to enter sewers/ surface or ground water.

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Trade name: ENVIROTEMP™ FR3™ Fluid

Methods and material for containment and cleaning up:

Send for suitable recovery and/or disposal authorities.

Contain and control the leaks or spills with non-combustible absorbent materials such as sand, earth, vermiculite, or diatomaceous earth in drums for waste disposal.

Clay materials (Fuller's earth, oil dry products) saturated with Envirotemp FR3 fluid can, under certain conditions, undergo a slow oxidation that releases heat. If the heat so released cannot escape, it is possible that the temperature may increase.

Reference to other sections:

See Section 7 for information on safe handling.

See Section 8 for information on personal protection equipment.

See Section 13 for disposal information.

7 Handling and storage

Precautions for safe handling: None

Information about protection against explosions and fires: No special measures required.

Conditions for safe storage, including any incompatibilities

Storage

Requirements to be met by storerooms and receptacles:

Avoid storage near extreme heat, ignition sources or open flame.

Protect from humidity and water.

Information about storage in one common storage facility: Store away from oxidizing agents.

Further information about storage conditions: Store in cool, dry conditions in well sealed receptacles.

Specific end use(s): No additional information.

8 Exposure controls/personal protection

Additional information about design of technical systems: No additional information.

Control parameters

Components with limit values that require monitoring at the workplace: Not required.

Additional information: The lists that were valid during the creation were used as basis.

Exposure controls

Personal protective equipment:

General protective and hygienic measures: No additional information.

Breathing equipment:

Not required under normal conditions of use.

Protection of hands:

Wash hands after use. For extended skin contact, gloves are recommended.



Protective gloves

The glove material has to be impermeable and resistant to the product. Selection of the glove material should be based on the penetration time, rates of diffusion and the degradation of the glove material. Wear protective gloves to handle contents of damaged or leaking units.

Material of gloves:

The selection of a suitable gloves does not only depend on the material, but also on the quality, and varies from manufacturer to manufacturer.

Penetration time of glove material:

The exact break through time has to be determined by the manufacturer of the protective gloves. DO NOT exceed the breakthrough time set by the Manufacturer.

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Eye protection:



Safety glasses

Body protection:

Protective work clothing may be required for spills.

Not required under normal conditions of use.

Limitation and supervision of exposure into the environment: No special requirements.

9 Physical and chemical properties

Information on basic physical and chemical properties

General Information

Appearance

Form:

Liquid

Color:

Light green

Odor:

Slight

Odor threshold:

Not determined.

pH-value:

Not applicable.

Change in condition

Melting point/Melting range:

Not determined.

Boiling point/Boiling range:

>360 °C / >680 °F /

Flash point:

>240 °C / >464 °F / (Closed Cup)

Flammability (solid, gaseous):

Not applicable.

Ignition temperature:

Not applicable.

Decomposition temperature:

Not determined.

Autoignition:

401 - 404°C (ASTM E659)

Danger of explosion:

Product does not present an explosion hazard.

Explosion limits

Lower: Upper:

Not determined. Not determined.

Oxidizing properties:

Non-oxidizing.

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Vapor pressure at 20 °C (68 °F): < 1.3 Pa (< 0.01 mm Hg)

Density at 20 °C (68 °F): 0.92 g/cm³ (7.677 lbs/gal)

Relative density at 20 °C (68 °F): Not applicable Vapor density: Not determined.

Evaporation rate: Nil.

Solubility in / Miscibility with

Water: Insoluble.

Partition coefficient (n-octanol/water): Not determined.

Viscosity

Dynamic: Not determined. Kinematic at 40 °C (104 °F): 33 - 35 mm²/s

Other information: No additional information.

10 Stability and reactivity

Reactivity

Chemical stability

Thermal decomposition / conditions to be avoided:

To avoid thermal decomposition, avoid temperatures > 250C.

Possibility of hazardous reactions:

Reacts with strong oxidizing agents.

Reacts with strong alkali.

Conditions to avoid: Store away from oxidizing agents. Incompatible materials: No additional information. Hazardous decomposition products: None.

11 Toxicological information

Information on toxicological effects

Acute toxicity: Not acutely toxic (OECD 420)

Primary irritant effect

On the skin: No irritant effect.
On the eye: No irritating effect.

Sensitization: No sensitizing effects known.

Additional toxicological information:

When used and handled according to specifications, the product does not have any harmful effects

according to our experience and the information provided to us.

The substance is not subject to classification.

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Trade name: ENVIROTEMP™ FR3™ Fluid

Carcinogenic categories

NTP (National Toxicology Program):

None of the ingredients are listed.

Repeated Dose Toxicity: None.

12 Ecological information

Toxicity

Aquatic toxicity: No Observable Adverse Effect > 10 000 mg/L (ASTM D608, OECD 203).

Oral toxicity: No Observable Adverse Effect > 2 000 mg/kg (OECD 420).

Persistence and degradability: Readily biodegradable.

Bioaccumulative potential: No potential for bioaccumulation.

Mobility in soil: Product has low mobility in soil.

Additional ecological information
Results of PBT and vPvB assessment

PBT: Not applicable. vPvB: Not applicable.

Other adverse effects: No additional information.

13 Disposal considerations

Waste treatment methods

Recommendation:

Product and packaging must be disposed of in accordance with relevant national and local regulations. May be incinerated. Unopened product may be returned for reclamation.

Uncleaned packagings:

Recommendation: Disposal must be made according to the applicable regulations.

Recommended cleansing agent: Water. Use cleansing agents, if necessary.

14 Transport information

UN-Number

DOT, ADR, ADN, IMDG, IATA: Not Regulated

UN proper shipping name

DOT, ADR, ADN, IMDG, IATA: Not Regulated

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Trade name: ENVIROTEMP™ FR3™ Fluid

Transport hazard class(es)		
DOT, ADR, ADN, IMDG, IATA Class:	Not applicable	
Packing group DOT, ADR, IMDG, IATA:	Not applicable	
Environmental hazards: Marine pollutant:	No	
Special precautions for user:	Not applicable.	
Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code:	Not applicable.	
UN "Model Regulation":		

15 Regulatory information

Safety, health and environmental regulations/legislation specific for the substance or mixture. SARA

Section 355 (extremely hazardous substances):

None of the ingredient is listed.

Section 313 (Specific toxic chemical listings):

None of the ingredient is listed.

TSCA (Toxic Substances Control Act):

All ingredients are listed.

Proposition 65 (California)

Chemicals known to cause cancer:

None of the ingredient is listed.

Chemicals known to cause reproductive toxicity for females:

None of the ingredient is listed.

Chemicals known to cause reproductive toxicity for males:

None of the ingredient is listed.

Chemicals known to cause developmental toxicity:

None of the ingredient is listed.

Carcinogenic categories

EPA (Environmental Protection Agency):

None of the ingredient is listed.

IARC (International Agency for Research on Cancer):

None of the ingredient is listed.

TLV (Threshold Limit Value established by ACGIH):

None of the ingredient is listed.

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MAK (German Maximum Workplace Concentration):

None of the ingredient is listed.

NIOSH-Ca (National Institute for Occupational Safety and Health):

None of the ingredient is listed.

OSHA-Ca (Occupational Safety & Health Administration):

None of the ingredient is listed.

State Right to Know Listings:

None of the ingredient is listed.

Canadian substance listings:

Canadian Domestic Substances List (DSL):

All ingredients are listed.

Canadian Ingredient Disclosure list (limit 0.1%):

None of the ingredient is listed.

Canadian Ingredient Disclosure list (limit 1%):

None of the ingredient is listed.

16 Other information

Date of preparation / last revision: 03/04/2014

Abbreviations and Acronyms:

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road).

IMDG: International Maritime Code for Dangerous Goods.

DOT: US Department of Transportation.

IATA: International Air Transport Association.

GHS: Globally Harmonized System of Classification and Labelling of Chemicals.

ACGIH: American Conference of Governmental Industrial Hygienists.

EINECS: European Inventory of Existing Commercial Chemical Substances.

ELINCS: European List of Notified Chemical Substances.

CAS: Chemical Abstracts Service (division of the American Chemical Society).

DNEL: Derived No-Effect Level (REACH).

PNEC: Predicted No-Effect Concentration (REACH).

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